REVISIONS			
LTR	**DESCRIPTION**	**DATE**	**APPROVED**

MIL-PRF-19500/404 has been cancelled.
This drawing may be used as a substitute.

Prepared in accordance with ASME Y14.100 — Selected item drawing

REV																				
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REV STATUS OF PAGES	**REV**																			
	PAGES	1	2	3	4	5	6	7	8	9	10	11	12	13	14					

PMIC N/A	**PREPARED BY** Roger Kissel	**DEFENSE SUPPLY CENTER, COLUMBUS** **COLUMBUS, OH** **http://www.dscc.dla.mil/programs/milspec/docsearch.asp**
Original date of drawing **9 June 2003**	**CHECKED BY** Alan Barone	**TITLE**
	APPROVED BY Thomas M. Hess	SEMICONDUCTOR DEVICE, DIODE, SILICON, RECTIFIER, MODULE, HIGH VOLTAGE, 1N5597, 1N5600, 1N5603, TX AND TXV
	SIZE A / **CODE IDENT. NO.** 037Z3	**DWG NO.** **03021**
	REV	**PAGE** 1 **OF** 14

AMSC N/A — 5961-E071

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1. SCOPE

1.1 Scope. This drawing describes the requirements for silicon, high voltage, rectifier modules. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Part or Identifying Number (PIN). The complete PIN shall be as follows:

03021	-	1N5597	TX, TXV
Drawing number		Device	Quality level

1.2.1 Device types. The device type shall be as follows:

Device type	Figure number
03021-1N5597TX, TXV	1
03021-1N5600TX, TXV	1
03021-1N5600TX, TXV	1

1.2.2 Quality levels. The TX and TXV-suffix part shall be as specified in MIL-PRF-19500 paragraph 3.3.

1.3 Ratings.

Types	V_{RWM}	$I_O = I_F$ T_C = 75°C	I_{FSM} T_C = 75°C	t_{rr}	$I_{R(surge)}$ T_C = 75°C	T_J and T_{STG}
	KV (pk)	A dc	A dc	µs	J	°C
1N5597	10	1.0 (1)	30	2	2	-55 to +150
1N5600	5	2.0 (2)	80	2	6	-55 to +150
1N5603	5	5.0 (3)	200	2	12	-55 to +150

(1) Derate linearly by 13.3 mA dc/°C from I_O = 1.0 A dc at T_C = +75°C. Derate to zero at T_C = +150°C.
(2) Derate linearly by 26.7 mA dc/°C from I_O = 2.0 A dc at T_C = +75°C. Derate to zero at T_C = +150°C.
(3) Derate linearly by 66.7 mA dc/°C from I_O = 5.0 A dc at T_C = +75°C. Derate to zero at T_C = +150°C.

1.4 Primary electrical characteristics at T_A= +25°C, unless otherwise indicated.

Types	V_F at I_F = rated I_F (see 1.3)	I_{R1} at V_R = rated V_{RWM} (see 1.3)	I_{R2} at V_R = rated V_{RWM} T_A = +100°C (see 1.3)	C V_R = 100 V dc f = 0.1 to 0.15 MHz	
	V dc	µA dc	µA dc	pF	
	Min Max	Min Max	Min Max	Min	Max
1N5597	13 19	1	75	5	30
1N5600	6 10	5	100	7	30
1N5603	6 10	5	100	15	40

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-202 - Electronic And Electrical Component Parts

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Defense Automation and Production Service (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D1868 - Standard Test Method for Detection and Measurement of Partial Discharge (Corona) Pulses in Evaluation of Insulation Systems.

D3487 - Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, USA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AMS-C-26074 - Coatings, Electroless Nickel, Requirements for.

(Application for copies should be addressed to SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-001.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.3 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and herein.

3.3.1 Internal construction. The rectifier module shall contain an assembly of series-connected discrete controlled avalanche diodes (arbitrarily designated D-1, D-2, and D-3 in tables I and II). Each diode shall be in a glass-to-metal, ceramic-to-metal, or fused metal oxide-to-metal hermetically sealed non-cavity package. The completed assembly of diodes and other internal structures shall be encapsulated in a plastic material which polymerizes to a rigid condition by virtue of a chemical cross-linking mechanism. The rectifier module shall be free of voids either visible or as evidenced by failure to pass the environmental corona test specified. The rectifier module shall not internally include nor utilize component capacitors and/or resistors for compensation. Only those discrete diodes which have passed the tests in 4.3, tables I, and II shall be used in the rectifier module. Discrete diodes shall be TX or TXV screened devices.

3.3.2 External construction. Metal surfaces shall be nickel plated in accordance with AMS-C-26074 (class 3, grade A). Plastic surfaces shall be finished smooth, free of pits, cracks, and other imperfections.

3.3.3 Polarity. Marking shall be in accordance with MIL-PRF-19500. As an option to the polarity marking requirements, a diode graphic symbol or the words cathode terminal may be used.

3.4 Performance characteristics. Performance characteristics shall be in accordance with table III.

3.5 Marking. The marking shall be in accordance with MIL-PRF-19500. It is not necessary that marking be on one line. Complete marking, which shall include part number, manufacturer's identification, Commercial and Government Entity (CAGE) code, and lot date code, shall be included on the initial packaging.

3.6 Manufacturer eligibility. To be eligible to supply devices to this drawing, the manufacturer shall have an approved facility in accordance with MIL-PRF-19500 for at least one line and at least one qualified JAN device listed on QML-19500. In addition, all devices specified herein shall meet all requirements of MIL-PRF-19500 except qualification. It is prohibited for a manufacturer not listed on the DSCC drawing approval bulletin to mark devices with this drawing number.

3.7 Submission of certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to be listed as a source of supply in 6.5. The certificate of compliance submitted to DSCC-VAC, prior to listing as a source of supply in 6.5, shall state that the manufacturer's product meets the applicable requirements of MIL-PRF-19500 and the requirements herein.

3.8 Certificate of compliance. A certificate of compliance shall be required from manufacturers requesting to be a suggested source of supply.

3.9 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.10 Workmanship. The semiconductor shall be uniform in quality and free from any defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Sampling and inspection. Unless otherwise specified, sampling and inspection procedures shall be performed in accordance with MIL-PRF-19500, and as specified herein.

4.2 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and tables I, II, and III herein.

4.2.1 Group A inspection. Group A inspection shall consist of the inspections and tests specified in table III.

4.2.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in paragraph 4.4.2.1. Electrical measurements (end-points) shall be in accordance with the applicable inspections of table III, subgroup 2 herein.

4.2.2.1 Group B inspection, table VIb of MIL-PRF-19500.

Subgroup	Method	Condition
1	2026	Not applicable.
2	4066	V_{RWM} = 0 V, I_{FSM} = (see 1.3) ten surges, 8.3 ms I_O = I_O rated at T_C = +75°C.
3	1036	Intermittent life test (modules may be series connected and horizontally mounted in a dielectric fluid such as 3M Brand FC40 or equivalent, or oil in accordance with ASTM-D3487, controlled to maintain a case temperature of 75°C minimum.) Time on = 50 min, time off = 10 min, duration = 340 cycles (340 hours). (For determining sample size, each module shallbe considered a test unit with resistive load.) I_O during time on: 1N5597 - 1 A dc 1N5600 - 2 A dc 1N5603 - 5 A dc.
4		Not applicable.
5		Not applicable.
6	1032	T_A = +150°C.

4.2.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table III, subgroup 2 herein.

Subgroup	Method	Condition
2	2036	Test condition D2 (stud torque), t = 3 s; torque for 1N5597 & 1N5600 = 18 inch-pound; torque for 1N5603 = 36 inch-pound.
3		Not applicable.
4	1041	Reject criteria, a device with illegible marking, evidence of flaking or pitting or corrosion that will interfere with the application of the device will be considered a failure.
5		Not applicable.
6	1036	Intermittent life test (modules may be series connected and horizontally mounted in a dielectric fluid such as 3 M's FC40 or equivalent, controlled to maintain a case temperature of 75°C minimum.) Time on = 50 minutes, time off = 10 minutes, duration 1,000 cycles (1,000 hours). (For determining sample size, each module shall be considered a test unit with resistive load.) I_O during time on: 1N5597 - 1 A dc 1N5600 - 2 A dc 1N5603 - 5 A dc.

4.3 Screening. Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table III herein. Devices that exceed the limits of table I herein shall not be acceptable. Screening shall be conducted on 100 percent of the discrete diode lot prior to assembly and encapsulation into rectifier modules.

Screen (see table IV of MIL-PRF-19500)	Measurement
	TX and TXV levels
(1)	Surge, see 4.3.2.
(2)	Peak Transient Reverse Power (table I)
9, 10	Not applicable
11	V_{F2} and I_{R1}
12	See 4.3.1
13	ΔV_{F2} = +0.1/-0.2 V dc ΔI_{R1} = 250 nA dc or 100 percent of initial value, whichever is greater, for D-1 (1N5597)and D-2 (1N5600). ΔI_{R1}= 500 nA dc or 100 percent of initial value, whichever is greater, for D-3 (1N5603). Electrical endpoints, table II, all tests

(1) Surge screening shall be performed anytime after screen 3 and before screen 10.
(2) Shall be performed anytime after screen 3.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: T_A = +125°C, V_R at rated (dc), I_F = 0.

4.3.2 Surge screening. See method 4066 of MIL-STD-750. V_{RWM} = 0, I_O = 0, I_{FSM} = 20 x I_O rated (see 1.3) at T_A = +25°C, t_p = 8.3 ms, 3 surges, duty factor = 1 percent maximum (half-sine or rectangular pulse of equivalent energy).

4.3.3 Internal corona screening. This 100-percent test shall be performed in accordance with 4.4.3 herein on the finished module.

4.4 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.4.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.4.1 Reverse recovery time. Reverse recovery time (method 4031 of MIL-STD-750) shall be measured in a circuit and with equipment as shown on figure 2. The pulse generator shall have a pulse repetition frequency of 1 kHz maximum, and a pulse width of 10 microseconds minimum. Recovery conditions: 0.5 ampere forward current to 1.0 ampere reverse current. Recovery time measured from the time the rectifier begins to conduct in the reverse direction (crosses I = 0) until the reverse current recovers to -0.25 ampere.

4.4.2 Peak transient reverse power. The circuit on figure 3 or a similar circuit, at the option of the supplier, shall be used to apply a single cycle reverse power surge to discrete diodes. The reverse power surge used to test discrete diodes may be applied in the form of a one-half sinusoidal pulse of 8.3 milliseconds duration.

4.4.3 Internal corona testing. Internal corona testing shall be conducted on all rectifier modules (see figure 4). The method of corona detection, measurement and display shall conform to the following requirements:

The terminals shall be connected together and connected to the high potential side of the corona test equipment. A test voltage of 25 KV(rms) at 60 Hz shall be applied between the terminals and the ground plane which shall be no more than 2 inches from the major diameter of the rectifier module. The test potential shall be applied for not less than 20 seconds. The corona tester shall be a Biddle Company AC Corona Tester (Catalog No. 661409), or equivalent. The corona discharge as viewed on the Biddle tester display screen shall show no more than 50 discharges per cycle (whole ellipse). None of the 50 discharges shall exceed 5 picocoulombs. In order to minimize the masking of internal corona by any external corona, rounded terminal hardware of suitable design may be added to the connectors during the corona test. In addition, the test may be performed with the unit either entirely or partially immersed in a suitable dielectric fluid in order to reduce external corona.

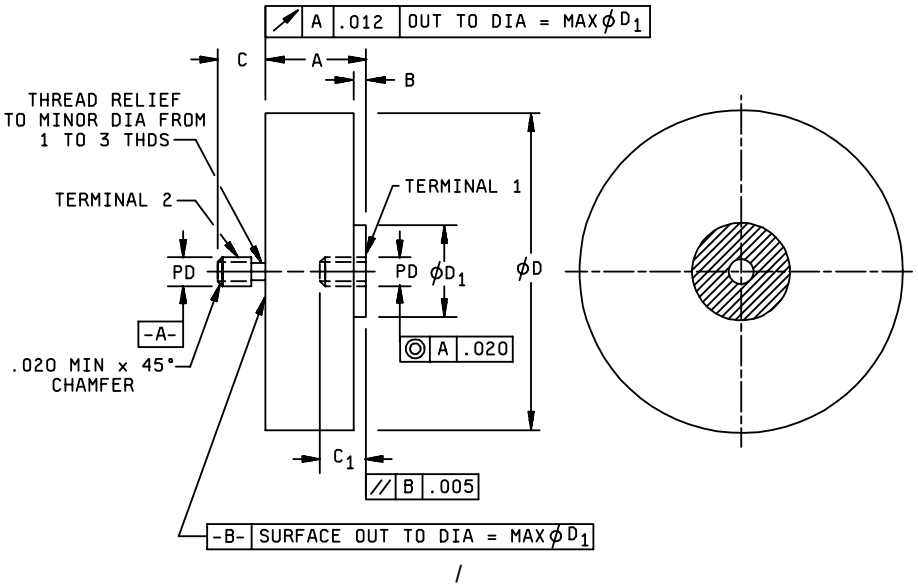
4.4.4 External corona testing. The method of corona detection, measurement and display shall conform to the requirements of ASTM D1868. The apparatus shall consist of a corona-free high-voltage adjustable power supply, a corona-free pickup network consisting of a high-pass filter, a corona detector consisting of a high-gain amplifier/oscilloscope, and a calibrating means to make quantitative measurement of corona magnitude in picocoulombs. Using the scheme shown on figure 5, an external corona test shall be conducted on two diode modules of the same rating connected in opposition from 0 V to the required test voltage of:

a. 20 KV(peak-to-peak) = 14.14 KV_{rms} for diode module type 1N5597.

b. 10 KV(peak-to-peak) = 7.07 KV_{rms} for diode module types 1N5600 and 1N5603.

With a corona detector sensitivity of 1 picocoulomb per 0.1-inch (2.54 mm) minimum, no corona discharges exceeding 5 picocoulombs shall be visible for types 1N5597 and 1N5600 and no corona discharges exceeding 15 picocoulombs shall be visible for type 1N5603. The number of detectable discharges shall not exceed 50 per cycle (whole ellipse).

4.4.5 Avalanche (bulk-breakdown) characteristic (test method 4023 of MIL-STD-750). The reverse breakdown characteristics shall be viewed on an oscilloscope with display calibration factors of 5 to 20 μA/division and 50 to 200 V/division. Reverse current over the knee shall be at least 50 μA. Each device shall exhibit a sharp knee characteristic and any discontinuity or dynamic instability of the trace shall be cause for rejection.



TYPE 1N5603 TYPES 1N5600 and 1N5597

Ltr	Dimension				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.970	1.020	24.64	25.91	14
B	.050	.080	1.27	2.03	
C	.307	.317	7.80	8.05	7, 12
C_1	.318	.400	8.08	10.16	9, 11, 12
ϕD	3.450	3.650	87.63	92.71	
ϕD1	.95	1.250	24.13	31.75	11, 13

Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.73	.83	18.54	21.08	14
B	---	.080	---	2.03	
C	.240	.264	6.10	6.71	6, 10, 12
C_1	.265	.400	6.73	10.16	8, 12
ϕD	1.85	1.95	46.99	49.53	
ϕD1	.57	.67	14.48	17.02	13

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Surface roughness of all external metal surfaces except threaded areas shall not exceed 63 microinches rms.
4. Threaded portions of the assembly shall be in accordance with NBS handbook H28 (Screw Thread Standards For Federal Services). The maximum pitch diameter of plated threads shall be the basic pitch diameter.
5. Location of marking is optional.
6. Threaded stud .250-28UNF-2A.
7. Threaded stud .375-24UNF-2A.
8. Threaded insert .250-28UNF-2B.
9. Threaded insert .375-24UNF-2B.
10. Cathode connected to terminal 2.
11. Cathode connected to terminal 1.
12. Full length thread.
13. Metal terminal contact surface.
14. Module contour within dimension A is optional.

FIGURE 1. Semiconductor device, diode module.

TABLE I. Discrete diode-process conditioning tests and measurements.

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Peak transient reverse power D-1 (1N5597) D-2 (1N5600) D-3 (1N5603)		See 4.4.2 single cycle surge; one-half sinusoidal wave 8.3 ms Surge = .17 J Surge = 1.00 J Surge = 2.00 J				

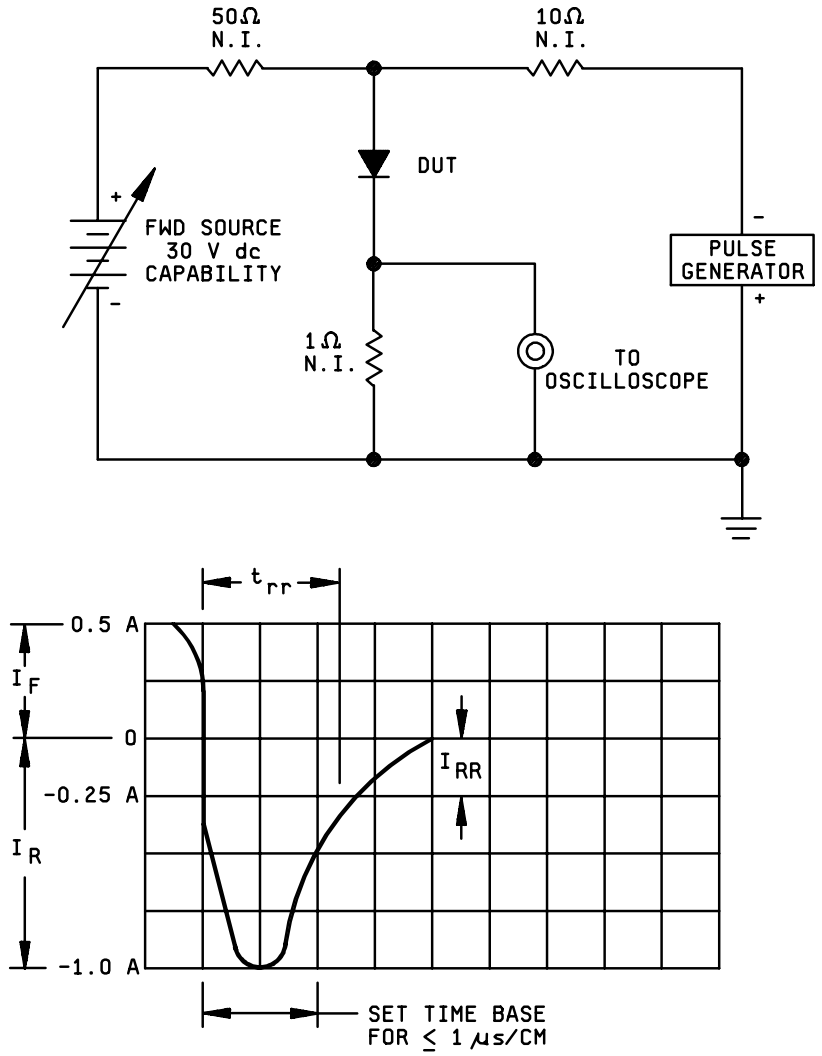
TABLE II. Discrete diodes-inspection test to verify sampling plan.

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1		100 percent test				
Avalanche (bulk-breakdown characteristics)		See 4.4.5				
Subgroup 2						
Forward voltage	4011		V_{F2}			
D-1 (1N5597)		I_F = 1.0 A dc			1.1	V dc
D-2 (1N5600)		I_F = 2.0 A dc			1.0	V dc
D-3 (1N5603)		I_F = 5.0 A dc			1.0	V dc
Reverse current	4016	DC method	I_{R1}			
D-1 (1N5597)		V_R = 600 V dc			1	µA dc
D-2 (1N5600)		V_R = 600 V dc			5	µA dc
D-3 (1N5603)		V_R = 600 V dc			5	µA dc
Breakdown voltage	4021	I_R = 10 µA dc	V_{BR1}	660		V dc
Breakdown voltage	4021	I_R = 50 µA dc	V_{BR2}		1,000	V dc

TABLE III. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Forward voltage	4011		V_{F1}			
1N5597		I_F = 1.0 A dc		13	19	V dc
1N5600		I_F = 2.0 A dc		6	10	V dc
1N5603		I_F = 5.0 A dc		6	10	V dc
Reverse current	4016	DC method	I_{R2}			
1N5597		V_R = 10.0 KV dc			1	µA dc
1N5600		V_R = 5.0 KV dc			5	µA dc
1N5603		V_R = 5.0 KV dc			5	µA dc
Subgroup 3						
High temperature operation:		T_A = +100°C				
Reverse current	4016	DC method; V_R = rated V_{RWM} (see 1.3)	I_{R3}			
1N5597					75	µA dc
1N5600					100	µA dc
1N5603					100	µA dc
Low temperature operation	4011	T_A = -55°C	V_{F3}			
1N5597		I_F = 1.0 A dc		13	24	V dc
1N5600		I_F = 2.0 A dc		6	12	V dc
1N5603		I_F = 5.0 A dc		6	12	V dc
Subgroup 4						
Capacitance	4011					
		V_R = 10.0 KV dc				
1N5597		0.1 MHz ≤ f ≤ 0.15 MHz		5	30	pF
1N5600				7	30	pF
1N5603				15	40	pF
Reverse recovery time		See figure 2 and 4.4.1	t_{rr}		2	µs
Subgroups 5 and 6						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.



NOTES:

1. Oscilloscope-rise time ≤ 7 ns; input impedance = 1 MΩ; 22 pF.
2. Pulse generator - rise time ≤ 10 ns; source impedance = 50Ω.
3. Recovery time shall be measured on the above circuit and with equipment as shown.

FIGURE 2. Reverse recovery time test circuit and characteristic nomograph.

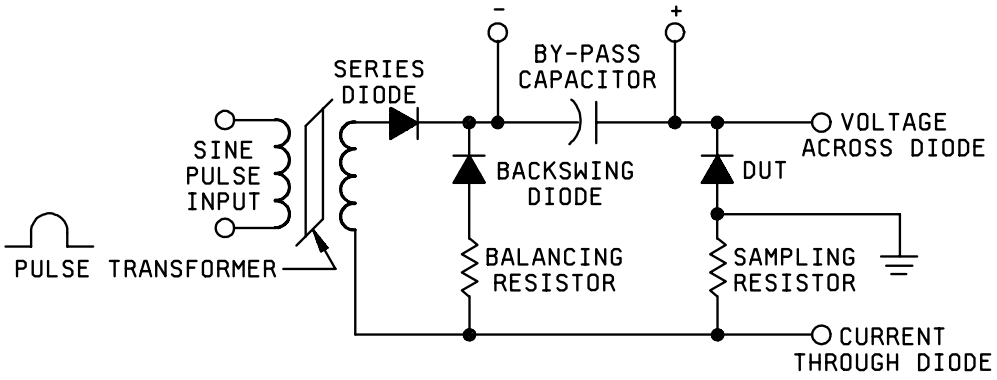


FIGURE 3. Peak transient reverse power test circuit.

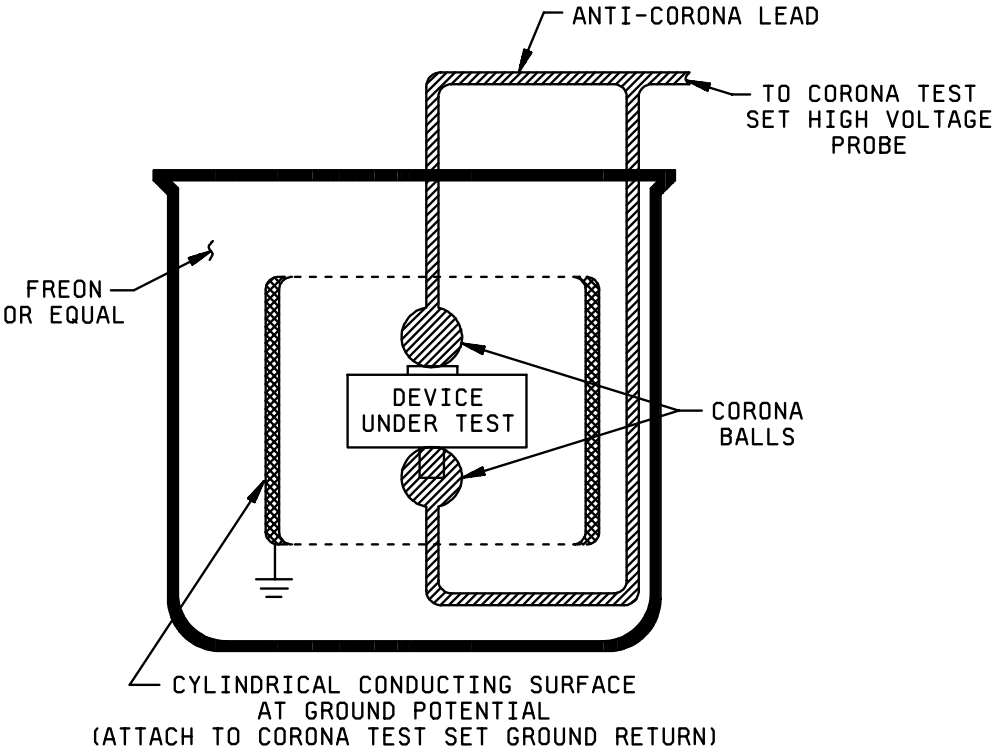


FIGURE 4. Internal corona test scheme.

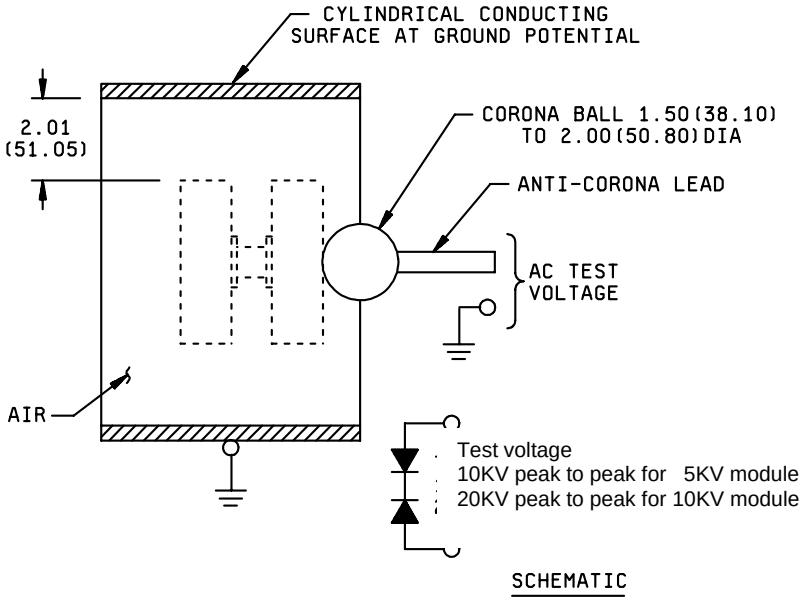


FIGURE 5. External corona test scheme.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2) in accordance with best practice. When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Devices conforming to this drawing are intended for use when performance specifications do not exist and qualified performance devices that will perform the required function are not available for OEM application. This drawing is intended exclusively to prevent the proliferation of duplicate specifications, drawings, and stock number listings.

6.2 Ordering data. The contract or purchase order should specify the following:

a. Complete PIN (see 1.2).

b. Requirements for delivery of one copy of the conformance inspection data or certificate of compliance that parts have passed conformance inspection with each shipment of parts by the manufacturer.

c. Requirements for packaging and packing.

6.3 Replaceability. Devices covered by this drawing may be used as a substitute for MIL-PRF-19500/404. All parts on this drawing are 100 percent interchangeable with devices supplied to MIL-PRF-19500/404.

DSCC drawing PIN (1)	Military part number	Vendor similar part number
03021-1N5597TX	JANTX1N5597	1N5597
03021-1N5597TXV	JANTXV1N5597	1N5597
03021-1N5600TX	JANTX1N5600	1N5600
03021-1N5600TXV	JANTXV1N5600	1N5600
03021-1N5603TX	JANTX1N5603	1N5603
03021-1N5603TXV	JANTXV1N5603	1N5603

6.4 Approved sources of supply. Approved sources of supply are listed herein. Additional sources will be added as they become available. The vendors listed herein have concurred with this drawing and have submitted a certificate of compliance (see 3.8 herein) to DSCC-VAC.

DSCC drawing PIN (1)	Vendor CAGE	Vendor name and address
03021-1N5597TX 03021-1N5597TXV 03021-1N5600TX 03021-1N5600TXV 03021-1N5603TX 03021-1N5603TXV	12969	Microsemi 580 Pleasant St Watertown MA 02472

(1) CAUTION: Items not acquired to this number may not satisfy the performance requirements of this drawing.

6.5 Users of record. Coordination of this document for future revisions are coordinated only with the suggested sources of supply and the users of record of this document. Requests to be added as a recorded user of this drawing should be in writing to: Defense Supply Center, Columbus, ATTN: DSCC/VAC Post Office Box 3990, Columbus, OH 43216-5000 or by telephone (614) 692-0510 or DSN 850-0510.

6.6 Comments. Comments on this drawing should be directed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, Post Office Box 3990, Columbus, OH 43216-5000.